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Electroluminescence from CdSe /PVA NanoComposites

KAMAL KUSHWAHA, PRIYANKA SHUKLA, DURGESH NANDINI, P. SINGH and M. RAMRAKHIANI

Department of Post Graduate Studies and Research in Physics and Electronics
Rani Durgavati Vishwavidhyalaya, Jabalpur (M.P.) India

ABSTRACT

The synthesis of polymer nanocomposites is an integral aspect of polymer nanotechnology. It has been shown that the optical properties of a material can be improved by inserting nanoparticles with its polymer matrix. CdSe/PVA Nanocomposites with various pH values have been prepared using chemical technique. The investigations of the prepared samples show that the smaller CdSe nanocomposits prepared with higher pH give EL in low voltage range.

1. INTRODUCTION

Cadmium selenide (CdSe) is well known luminescent material and being used in various devices like UV light emitting diodes, flat panel displays, photo-voltaic device etc. The effect of reducing the size of CdSe crystals is expected to improve the performance of these devices. The properties can also be tuned by incorporation of nanoparticles in polymer matrix. The present work reports the preparation of CdSe nanocrystal in polyvinyl alcohol (PVA) matrix and their electroluminescese studies at various voltages and frequencies.

2. EXPERIMENTAL

20ml PVA solution was taken and 1ml $CdCl_2$ (0.01M) was added with constant stirring. Ammonia solution was then slowly added until a clear solution was obtained. The pH value was adjusted with dilute acetic acid. An appropriate amount of freshly prepared(1M) selenosulfate solution was introduced in order to achieve the required metal/selenium molor ratio.The mixture was stirred for 3h at room temperature to obtain a transparent solution. The solution was cast on a glass substrate and conducting glass plate. Upon solvent evaporation, a PVA-cadmium selenide composite film was obtained. The samples were prepared by varying pH values (8, 10 and 12). Optical absorption spectra of the samples were recorded in the range of 300-800nm by Perkin Elemer Lambde-12 spectrometer. EL cell was prepared by depositing nanocomposite layer over Sno_2 coated, glass plate. Aluminium foil was used as second electrode. EL has been investigated for all the three samples of CdSe/PVA nanocomposite.

3. RESULTS & DISCUSSION

Figure 1 shows the optical absorption spectra of CdSe/PVA nanoparticles composits prepared with varying pH values from 8 to 12. It is observed that there is no absorption from higher wavelength region up to 440nm. At lower wavelength an absorption peak is obtained. The absorption peaks are found at 420nm, 410nm and 390 nm corresponding to 8pH, 10pH and 12pH respectively shifts towards lower wavelengths as pH value is increased.

The increase in the effective band gap of nanocrystals as a function of crystalline size can be estimated by effective mass approximation.

$$\Delta E= \hbar^2\pi^2/2r^2\,[1/M_e^* + 1/M_h^*]$$

Where ΔE is increase in the effective bandgap, r is particle size, M_e and M_h are effective masses of electron and hole respectively.

The effective band gap (Eg) of the CdSe nanocrystals is obtained from the absorption spectra and increase in the bandgap (ΔE) has been determined by subtracting bond gap for bulk 1.74 eV. The particle size estimated is of the order of 3-4 nm.

Samples	pH	Wave length at absorption peak (nm)	Band Gap Eg (eV)	Particle size (nm)
CdSe-pH8	8	420	2.95	3.5
CdSe- pH10	10	410	3	3.4
CdSe-pH12	12	390	3.2	3.2

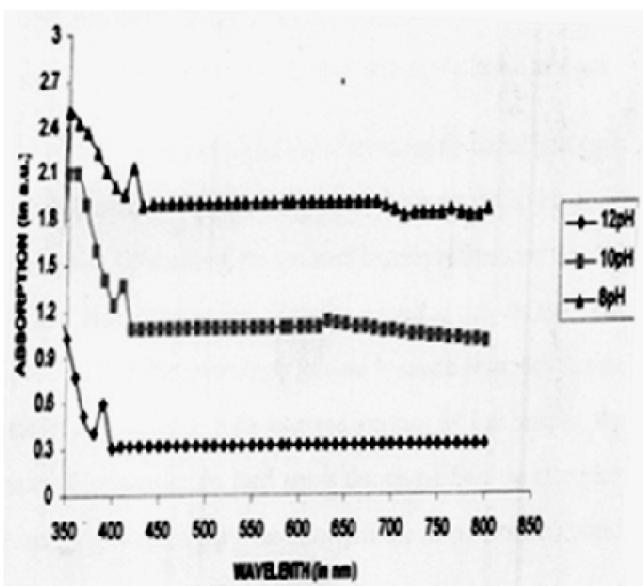

Fig.1

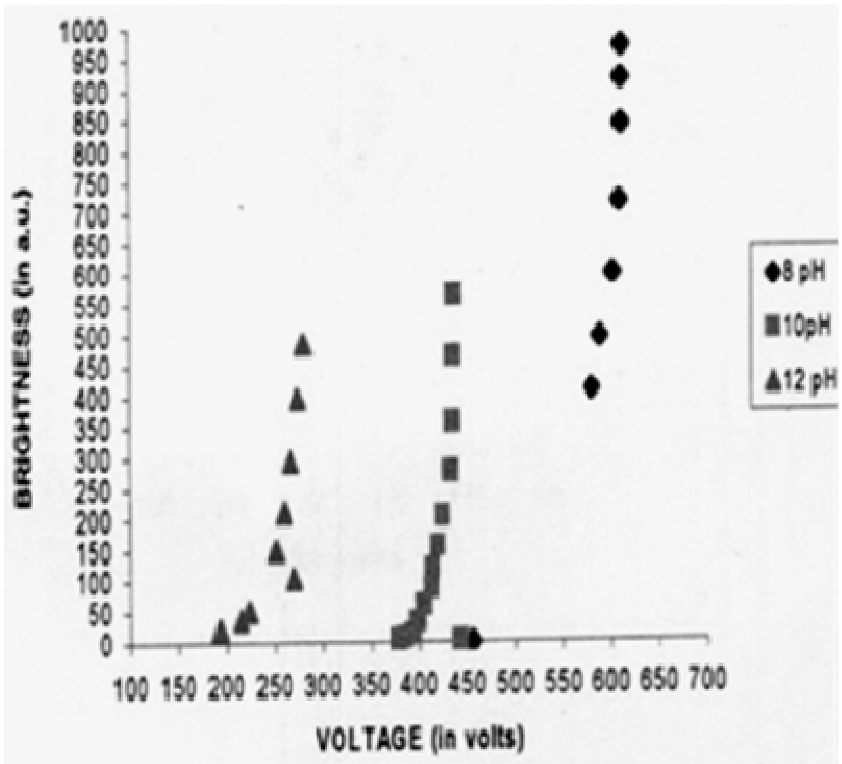

Fig. 2

It is observed that by increasing pH value during the reaction effective band gap of CdSe nanoparticle increases, indicating reduction in particle size.

It is observed that EL starts at a threshold voltage and then increases rapidly with increase voltage. The lower threshold and higher brightness have been observed for CdSe prepared from higher pH concentration. As voltage is increased, more electrons and holes are injected into the emission layers and their subsequent recombinations increase the EL brightness. It is observed that at high frequency light emission starts at lower threshold voltages and electroluminescence brightness increases with increasing frequency. The nature of frequency dependence of EL brightness can be understood on the basis that the emptying and detrapping of EL centers more rapidly with increase in frequency. The current voltage characteristic of EL cells shows the ohmic nature. Figure 2 shows the voltage brightness characteristics of CdSe nanocomposite at 1000Hz frequency.

4. CONCLUSION

The investigations revealed that the smaller CdSe nanocomposits prepared with higher pH give EL in low voltage range.

Even the threshold voltage for the samples prepared with lower pH is greater than the maximum voltage applied to the smaller CdSe nanocomposites.

5. REFERENCES

1. J, Cheng, S, Wang, X, Y, Li, Y, J, Yan, S. Yang, C, L, Yang, I, N. Wang, and W, K, Ge, Chemphys. Lett, 333, 375-380, (2001).
2. L, D. Sun, X, F. FIL, M, W. Wang, C. H, Liu, C, S, Liao, C. II, Yan, *J. Lumin*, 87, 538 (2000).
3. L. Brus. *J. Chem. Physics*, 79, 5566, (1983).
4. M. V., Artemyen, L., I., Gurinovoch, A, P, Stupak and S, V, Graponenko, *Phys. State, Vol*. 224, 191 (2001).
5. S, H. Yu., Y, Yang, Z, H, Hen, y. Zhou, R. Y. Yang, *J. Mater, Chem*. 9, 1293 (1999).
6. Y, Zhou, S, H, Yu, C, Y, Wang, X, G, Li, Y, R, Zhu, Z, Y, Chen, Chan, Common 1229 (1999).